The degradability and nutritive value of black cumin cake *(Nigella sativa)* as a feed for ruminants

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SUMMARY

Mechanically oil extracted cake of black cumin seeds (BCC), *Nigella sativa*, was analyzed to determine the chemical composition. Crude protein (CP) and dry matter degradability (using the nylon bag technique), effective degradability and degradation characteristics for evaluation as an animal feed compared to that of peanut cake (PNC) as a standard. Rumen fluid from a fistulated bull was used to estimate the metabolisable energy (ME) according to the gas production technique. The results showed that the chemical composition and ME of BCC were as follows (as %): DM 92.7±0.77 was lower than PNM (94.5±0.51), ash 15.0±0.65 was higher than PNM 9 (9.6±o.93), CP 22.2±0.92 highly was lower than PNM (47.8±1.08), CF 15.6±0.58 was higher than PNM (9.4±0.78), EE 9.6±0.84 was higher than PNM (7.5±0.64), NFE 23.4±o.64 was lower than PNM (25.7±0.66), and ME 11.5 MJ/kg, almost similar to PNM (11.2). The effective degradability, the very rapidly degradable components, the slowly degradable components and the rate of degradation were: 69.3, 41.9, 46.1 and 0.06 respectively. BCC have a high DM and CP potential degradability (91.5 and 95.2 successively), the high contents of DM (92.7 %), CP (22.2%) and CF (15.6%) suggested that BCC could be used as a good source of protein supplement for ruminant animals.

INTRODUCTION

Substitution of traditional supplements in ruminant nutrition is common practice as economic conditions change. Proteins of plant origin are far less expensive than that of animal origin. Because of this reason more attention is being paid to discover and exploit non-traditional sources of plant proteins.

Major oilseeds producing crops like peanut, cotton, sesame, and sunflower are grown in irrigated as well as rain fed agricultural schemes in the Sudan. Oilseeds represent an important commodity as a source of oil for human needs and also provide cake rich in crude protein, which is a valuable industrial by product as an animal feed. Sudan is one of the major oil seeds producing countries.

Nigella sativa (*N. sativa*) or black cumin belongs to the botanical family of Ranunculaceas and commonly grows in the Sudan on the banks of the River Nile. It is also commonly grown in Europe, Middle East and Western Asia. Arabic names of the seed are Al-Habba Al-Sawda, Habbet Al-Baraka and Kamoun Aswad; and in English language are known as black seed and black Carawy.

The multiple uses of the seeds of *N. sativa* and its extracted oil in the folk medicine in the Sudan and other parts of the world encouraged many investigators to isolate the possible

active components and to conduct many studies in order to understand its pharmacological actions (Babayan *et al*., 1978 and Randhawa and Al-Ghamdi, 2002). In addition to that, it is also used as a flavoring additive to bread, cakes, cheese and prickles.
The use of *N. sativa* seeds or its cake as an animal feed was not reported in literature; hence, the objectives of the study reported here were to use laboratory nutritional techniques to evaluate the cakes of the mechanically extracted black cumin seeds through chemical analysis, degradability and metabolisable energy content.

MATERIALS AND METHODS

Nigella sativa or black cumin cake (BCC) and peanut cake (PNC) were ground through a 2mm screen of a Willy laboratory mill. Two replicate samples from both cakes were analyzed according to the A.O.A.C. method (1975) to determine the chemical composition. A rumen fistulated Baggara bull (obtained from the Animal Production Research Center in Hillet Kuku) was used to determine the rumen degradation of the cakes. The animal was kept in a shaded area and was offered a daily concentrate molasses feed ration composed of 50% molasses, 21% ground sesame cake, 25% wheat bran, 2% salt, 2% urea and 1% lime stone at maintenance level. Sorghum straw was fed *ad libitum*. Clean water was supplied 24 hours a day. A weight of five grams of both cakes were put in nylon bags, tied and incubated in the rumen through the rumen fistula of the bull as was described by Mehrez and Ørskov (1977). The bags were assigned randomly for each incubation time point. Three bags from both samples were selected at random for each time period (3 bags / diet / period). The bags were removed at intervals of 0, 1, 3, 6, 12, 24, 36, and 48 hours. After removal, each bag was rinsed with tap water until the rinse water was colourless and dried for 24 hours in a forced air oven at 70˚C. Residues in the bags were removed, kept in a plastic vial, ground in a Willey Mill through a 1 mm screen. They were digested in H^2SO4-H^2O^2. Nitrogen content was determined by Nessler reaction and read in a Spectrophotometer DU series 60. Dry matter (DM) disappearance was calculated based on original DM composition, while nitrogen disappearance was calculated based on nitrogen content according to the A.O.A.C. (1975). The effective degradability (Pe) was calculated by applying the mathematical model proposed by McDonald (1981).

$$P = a + bc / (c + k)$$

Where:

- a = the very rapidly degradable components.
- b = the slowly degradable components.
- c = the rate of degradation.
- e = natural logarithm
- t = incubation time in hours.
- k = the outflow rate from the rumen (assumed to be 0.05).

The potential degradability (PD) was calculated by the model of Ørskov and McDonald (1979),
where: $P = a + b (1 – e^{-ct})$.

Data analysis was done using regression (Gomez and Gomez, 1984) and differences between means were evaluated by T-test and values ≤ 0.05 were considered significant.

RESULTS AND DISCUSSION

Table (1) shows the chemical composition and metabolisable energy (ME) values of the BCC. As observed, BCC differed from PNC in ether extract (EE), crude fiber (CF), crude protein (CP) and ash content. BCC was higher in CF, EE and ash, while it was low in CP and DM. The metabolisable energy of both cakes looked similar. The small difference observed may be due to the conditions of extraction and to the mechanical process used for oil extraction as was reported by Husby and Korening (1971) and Ishag (1986), who stated that the nutritive value of cakes might differ according to the method of extraction. The CP of BCC was lower when compared to other Sudanese oil cakes like Karkadi (38%) and sunflower (26.9%) as reported by Sulieman and Mabrouk, (1999). The high level of ME in both cakes might be due to the incomplete process of extraction of the oil due to the method used.

The disappearance of DM and CP of BCC and PNC (gm/100 gm) from the rumen of a fistulated Baggara bull was shown in table **(2).** It was clear that as the incubation period increased, the amount of DM and CP disappearing increased. At the zero hour considerable disappearance of DM and CP of both cakes was observed which might be related to the high solubility of their cell contents, and could also be taken as an indicator for the availability of readily soluble matter needed as immediate nutrient for rumen microorganisms as when feeding totally mixed ration (TMR) high in roughages. However, DM disappearance of BCC was significantly lower than that of the control.

Table 1. The chemical composition and the metabolisable energy (ME) of black cumin cake compared to that of peanut (Mean ± S.E.).

Type	DM	Ash*	CP**	CF*	EE	NFE	ME[1]
	gm/100gms						
Black cumin cake	92.7	15.0	22.2	15.6	9.6	23.4	11.5
S.E.	±0.77	±0.65	±0.92	±0.58	±0.84	±0.64	
Peanut cake	94.5	9.6	47.8	9.4	7.5	25.7	11.2
S.E.	±0.51	±0.93	±1.08	±0.78	±0.64	±0.66	

(1) In MJ/kg DM.
* *(P < 0.05).*
** *(P < 0.01).*

In both cakes, the rate of DM and CP disappearance (gm/100gm) increased with the progression of time following the same trend. The disappearance of CP of BCC was insignificantly lower than that of PNC (P>0.05). That could be attributed either to the low solubility of CP of BCC or to the anti-microbial effect of BC seeds reported by Topozada *et al*., (1965), El-Fatatry (1975) and Morsi (2000), but that, from the nutritional point of view, also might indicate the availability of more bypass protein of BCC compared to that of PNC.

Table (3) represents the degradation characteristics of the two types of cakes under investigation. Both cakes had a relatively high effective degradability of DM and CP. However, the PNC had significantly (P>0.05) higher values.

Table 2. The dry matter (DM) and crude protein (CP) disappearances of black cumin and peanut cakes from the rumen of fistulated Baggara bulls at different incubation periods.

Incubation Period (h)	DM and CP disappearance (%) black cumin cake DM	CP	peanut cake DM	CP
1	53.4	39.8	52.5	41.4
3	60.0	48.1	60.5	50.3
6	64.0	62.1	62.2	61.7
12	70.6	80.2	72.2	82.5
24	82.2	87.4	85.5	87.7
36	88.0	93.5	92.5	94.2
48	91.5	95.2	94.7	97.3

DM quality of a nutrient can be generally defined as the ability of a specific nutrient to provide energy, amino acids and micro nutrients in the required amounts to a given animal performing specific functions such as growth, milk production, egg production. Babayan *et al*., (1978) reported that *N. sativa* seeds contained significant amounts of essential amino acids, carbohydrates and minerals that made it an excellent food additive for human food the same could be said in the case of its cake as an animal feed.

In table **(3),** the results of this study showed that BCC have a high DM and CP potential degradability (91.5 and 95.2 successively), but lower than that of PNC (94.7 and 97.3 successively). The disappearance and the readily soluble DM of BCC (Tables 2 and 3) were significantly lower than that of PNC ($p < 0.05$), which is an indicator of more by-pass nutrients other than protein in BCC.

Protein rich feedstuffs are generally considered among the most costly components of animal rations, thus BCC could be taken as a reliable animal feedstuff rich in crude protein.

Table 3. The effective degradability (Pe) and the degradation characteristics of DM and CP of black cumin cake compared to that of peanut.

Cake	DM						CP					
Type	a	b	a+b	C	PD	Pe	a	b	a+b	C	PD	Pe
BCC	41.9	46.1	88.0	0.06	91.5	61.1*	29.5	57.1	86.6	0.06	95.2	69.3
PNC	47.2	45.4	92.6	0.06	94.7	67.3	29.4	57.6	87.0	0.06	97.3	74.1

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القيمة الغذائية لكسب الكمون الأسود (*Nigella sativa*) كمصدر للبروتين في غذاء المجترات

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ملخص البحث:

تم تحليل عينات من كسب الكمون الأسود (الحبة السوداء) الذي تم استخلاص محتوياته من الزيت ميكانيكيا، وذلك لتحديد مكوناته الكيمائية. تم استخدام عدد أثنين ثور بقارة، مجهزة جراحيا بناسور فى الكرش، وذلك لتعيين معامل تكسر المادة الجافة والبروتين الخام للغينات عند تحضينها في أكياس من النايلون داخل الكرش لفترات محددة. هذا بالإضافة آلي استخدام سائل الكرش من هذه الثيران لتقدير طاقة الايض للعينات حسب بتقنية إنتاج الغاز (التخمير). جرى مقارنة كل ذلك بعينات من كسب الفول السوداني، حيث أن محتوياته الكيمائية محددة ومعروفة. أوضحت النتائج بأن القيمة الغذائية لعينة كسب الحبة السوداء عالية، كما وأن المحتوى العالي من البروتين الخام، 222 جم/كجم، في الكسب المستخلص ميكانيكيا، يشير إلى إمكانية الاستفادة من كسب الكمون الأسود كمصدر تدعيم بروتيني للمجترات. كما أوصت الدراسة كذلك أن محتويات كسب الحبة السوداء من المادة الغذائية والبروتين الخام علي درجة عالية من التآكل داخل الكرش (91,5% و 95,2%) علي التوالي.